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A Good Life for More People

Today 74 percent of all Americans inhabit only 2 percent of our land. Much of the present general malaise, sociologists and psychologists tell us, traces to the stress and strain of modern urban life. Yet many million more Americans may be on the scene by the year 2000. Where will these people live, work, and play? Even more important—what can be done to improve the overall quality of life?

These and related topics make up the scope of the latest Yearbook of Agriculture, *A Good Life for More People*. Its 416 pages tell us how we can enhance life for future generations by providing jobs, housing, services, and recreation in country and small-town America where there is ample room for economic and residential expansion. A redistribution of population during the next three decades, experts believe, could relieve the pressure on metropolitan centers, give rise to new and more livable cities, and rejuvenate declining small towns. Although the 1971 Yearbook's authors have no illusions about the complexity of problems associated with rapid growth, their outlook is hopeful.

As century 21 approaches, two major missions will engage agricultural research: Feeding a burgeoning population and safeguarding the environment. ARS contributors to the Yearbook hold that agriculture can meet both challenges. For example, cereal germ plasm now available will enable plant breeders to develop varieties with balanced amino acids and protein contents rich enough to nourish people should population pressures divert grains from livestock feeds to direct consumption. Similarly, ARS animal scientists foresee more efficient livestock production through steady improvements in genetics and rations. If grain is diverted to people, livestock producers will depend more on grass, other forages, and byproducts that ruminants readily convert to food.

The words "ecology" and "environment" appear frequently in the chapters authored by ARS scientists. They note some of the advances made in fighting pollution: turning pollutants into products, developing noninsecticidal approaches to insect control, breeding plants that stabilize soils in varied ecosystems. An underlying theme is the need for awareness of ecological consequences in the use of technology.

The Yearbook charts the way toward a good life, where balance replaces fragmentation, and man lives in harmony with man and land. We can strike out to restore what was so fittingly described in times past as "the commonweal". This could be the journey of our time.

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COVER: This high-contrast reverse photo highlights the bracts of frego cotton that disorient and foil the boll weevil during egg-laying. See page 3 (PN-1993).

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FREGO BRACT, an odd cotton mutant, has all the earmarks of a psychological bomb for the boll weevil. In fact, cotton scientists believe they may have one of the keys to biological control of the weevil.

Controlling this insect biologically would do more to decrease the use of pesticides in agriculture than any other single factor. About 40 percent of all agricultural insecticides are used for cotton insect control. And boll weevil control alone accounts for 30 percent.

Frego's psychological bomb lies in the fact that it has unusually narrow, twisted bracts which are not suited to the weevil's egg-laying habits. In normal cotton, the bracts are broad and leaflike, offering the weevil a preferred environment for egg-laying. Bracts are leaflike structures surrounding the buds which develop into cotton bolls.

Frego cotton came into existence about 1940 when an Arkansas cotton farmer named Frego found an odd cotton plant in one of his fields. Mr. Frego saved the seeds and planted them the following season. All of the plants came true to the parent. He continued the

BRACTS_

foil boll weevils

Research assistant Jack C. McCarty, graduate student at Mississippi State University, examines the narrow, twisted bracts of frego cotton. The bract characteristic is inherited as a single recessive gene (0971K1233-28).



project until he had a few acres of this cotton.

After Arkansas and Louisiana scientists reported less boll weevil damage to frego bract cotton than to normal cotton in small plots, geneticist Johnie M. Jenkins and entomologist William L. Parrott, both of ARS, began laboratory and field studies in cooperation with the Mississippi Agricultural Experiment Station, State College. In 1970 they grew several 10- to 20-acre fields of frego bract cotton on four farms in different parts of Mississippi.

Their studies showed that frego bract reduced the boll weevil population 66 to 94 percent when compared to fields of nonfrego cotton. On two farms, no insecticides were necessary for weevil control in the frego fields during the growing season.

The highest percentage of weevil suppression by frego occurred in fields with lowest weevil population. This fact leads the scientists to believe that frego cotton over a period of years could play an important role in an integrated approach to boll weevil eradication.

Motion picture films of the female boll weevil's reaction to the abnormal cotton bracts were made by ARS entomologists William H. Cross and Henry C. Mitchell, State College, Miss. The films show that the narrow, twisted bracts seem to disorient and confuse the female weevil so that she spends about eight times longer than normal moving about the plant and thus spends much less time in egg-laying.

Dr. Jenkins believes it unlikely that boll weevil females will rapidly adjust to the frego bract, since this adjustment would involve a change in the insects' inherited behavior pattern. If it should happen in the distant future, then cotton with normal bracts could perhaps be safely planted once again.

Although frego cotton is not of a sufficiently high quality for commercial use, Dr. Jenkins says that the abnormal bracts could possibly be bred into high-quality cottons within perhaps 5 years. □



Above: Bracts of standard commercial cotton are broad and leaflike (0971K1233-21). Below: The peculiar shape of the frego bracts alters the environment around the flower bud which is the principal site for weevil feeding, egg-laying, and resting. The weevil resistance of frego is not merely a matter of nonpreference, which would shortly disappear, but is caused by a change in the natural behavior pattern of the weevil (0971K1234-17).



For better insect control

FOAM FINDS THE TARGET

FOAM'S VERSATILITY is being called into the search for better corn borer control with less chance of environmental pollution.

Foam finds its way to the whorls and leaf axils of corn plants so effectively that it is proving an excellent insecticide vehicle. Nearly all of the insecticide applied in the foam stays on the plant, thereby reducing soil and air contamination.

This method of application promises equal or better insect control than present spray or granule applications whereby only a small portion of the insecticide hits the target area.

Previous work established that a small quantity of DDT (used only as the best available standard for comparison) or *Bacillus thuringiensis* placed in the corn whorl at the correct time will control first-brood corn borers. *B. thuringiensis* is a bacterium that produces protein crystals toxic to some insects, including the corn borer. Correct application time is when the borers are hatching and are in the whorls to feed.

Second-brood borers can be controlled by placing, some weeks later, a small quantity of insecticide on the leaf axils close to the ear.

These investigations were conducted by entomologists and agricultural engineers at the Corn Borer Research Laboratory, Ankeny, Iowa. The researchers also found that wet foam was superior to dry foam, which had a tendency to stick to leaves and not run as well as wet foam. Rates of liquid over 20 gallons per acre produced the best control.

A trifluid nozzle was designed and built to generate foam. Insecticide mixed with water, liquid foaming agent, and air were combined in the nozzle and forced through a meshed material. The volume of foam and its consistency were controlled by the amounts of insecticide, foaming agent, and air combined in the nozzle. Two types of distributors that attached to the foaming nozzle were evaluated. One produced a single large stream of foam; the other, three smaller streams. Type of distributor had little or no effect on

control for either first or second broods.

Foam formulations of DDT and *B. thuringiensis* gave approximately the same level of control as granules and significantly better control than sprays for both the first and second broods.

Moreover, less pesticide was needed with foam. DDT applied in foam at 1½ lb/a was about as effective as granules at 1 lb/a and sprays at 1½ lb/a. With the bacterium, foam applications at one-half the recommended rate (1 lb/a) produced equal or better control than existing methods of application at the full rate (2 lb/a).

B. thuringiensis has given fair to good borer control in the past and offers some potential for reducing pollution by replacing potentially hazardous chemicals. Foam application is "made" for the bacterium because of the increased deposition efficiency.

This project, in cooperation with the Iowa Agriculture and Home Economics Experiment Station, Ames, is part of USDA's continuing program to combat effectively pests of man and his food supply and, at the same time, to preserve and protect the quality of man's environment. □

Left: Specially designed trifluid nozzle applies foam insecticide to control first-brood corn borer (BN-38513). **Right:** Foam runs into the corn whorl, thus delivering the insecticide right to the target area for borer control (PN-1994).





How much sulfur for cattle?

NATURAL PROTEIN SOURCES like soybean meal supply a major portion of cattle's sulfur requirements. But with the growing use of urea and other nonprotein nitrogen (NPN) sources, cattlemen are concerned about sulfur supplementation.

That's why ARS animal nutritionists undertook experiments to determine exact sulfur needs of cattle and to outline the symptoms and consequences of too much or too little sulfur in the diet.

"Sulfur deficiency of cattle fed NPN sources is a possible new problem area, and very little can be found in the literature that relates to cattle," reports ARS beef nutritionist Robert R. Oltjen. Symptoms of sulfur deficiency include decreased feed intake, emaciated appearance, dullness, and loss of hair.

Traditionally, it was thought that an animal needed a 15:1 nitrogen to sulfur ratio in the feed, a ratio corresponding to the composition of body tissue.

But recent Australian research with sheep indicated that the 15:1 ratio was too wide and that a 10:1 ratio improved performance. However, this did not fill the information gap for cattle.

A visiting nutritionist with ARS on leave from the South Carolina Agricultural Experiment Station, William Chalupa led the sulfur investigations at Beltsville, Md. He worked with Dr. Oltjen and ARS microbiologist Leonard L. Slyter.

The first study was aimed at finding basic information about sulfur needs. Twenty Holstein bull calves weighing approximately 220 pounds each were fed a purified diet (all dietary nitrogen from urea) for 77 days. The ration was modified to contain an 86:1 nitrogen:sulfur ratio, which represented a sulfur-deficient diet.

Sulfur in elemental form was added to the basic experimental diet to make: 12:1 ratio—adequate sulfur supply;

4:1—excess sulfur; 2:1—excess sulfur.

Calves on the sulfur-deficient diet lost about 0.3 pounds per day, while those on the remaining diets gained 1.6, 1.7, and 1.8 pounds daily, respectively.

"Excess" sulfur levels, expected to be toxic, produced no toxicity symptoms. The scientists concluded that the 12:1 level was adequate.

A second test considered practical management for the beef producer. Thirty-two Angus steers, about 400 pounds each at the start of the study, were fed a semipurified diet in which urea made up two-thirds of the dietary nitrogen. The steers were divided into two groups and received this ration with sulfur added in either elemental form or as sodium sulfate.

Sodium sulfate is a commonly used sulfur source. The elemental form was used to represent a less expensive source. Four nitrogen:sulfur ratios were fed within each group. All animals



Dr. Chalupa holds calves while Dr. Oltjen records measurements, Left: Calf fed sulfur-adequate diet (570A490-19). Above: Calf on sulfur-deficient diet (570A490-9).

were fed free choice for the first 84 days, then were allowed to eat at the rate of 2 percent of each steer's body

Source of sulfur had little effect on daily gains or biological differences. weight in feed during the succeeding 84 days.

The 16:1 ratio was adequate but, as shown in the first study, no harmful effects were observed at higher levels. A 38:1 ratio produced somewhat lower gains.

"In view of the evidence from these studies, beef cattle receiving a third to a half of their dietary nitrogen from NPN sources probably don't need additional sulfur," Dr. Chalupa concluded. "The farmer doesn't have to worry about adding sulfur, but if he does, a little too much does no harm."

The findings from these studies are primarily applicable to beef cattle and cannot be carried over to sheep or lactating cows without further study. □

Trenching Tomatoes

SHALLOW TRENCHES for planting tomatoes in Lower Rio Grande trials increased the yields of marketable tomatoes by 5 tons per acre.

Advantages of the trenches over conventional planting on top of beds were higher nighttime soil temperatures, reduced wind damage to the young seedlings, increased soil water, and lower accumulation of salt in the seedbed.

Equally important, the tomatoes in trenches matured 3 weeks earlier while producing the significantly higher yield—102 versus 65 pounds per 50-foot row. That's 14 tons per acre in the trenches compared with 9 conventionally.

Texas growers compete with California, Florida, and Mexico for early markets, and the early maturing date could make quite a difference in the price received for fresh tomatoes. Price difference between early-spring and late-spring fresh-market tomatoes in 1969 was \$3.70 per hundred pounds (\$13.90 vs. \$10.20) in Texas.

ARS soil scientists Candelario L. Gonzalez and Marvin D. Heilman began the study in Weslaco, Tex., after previous work there showed that trench planting reduced the cost of foaming material for frost protection (AGR. RES., March 1971, p. 4).

The scientists planted single rows of tomatoes (Homestead 24) in the bottom of a trench, 6 inches deep and 4 to 7 inches wide, placed

in the center of a conventional 38-inch lister bed. Single rows of tomatoes were planted conventionally on top of 38-inch planed beds.

The scientists excavated the trenches using a three-row rotary corrugator and prepared the ridges with conventional equipment.

Soil temperatures, soil water, and wind speed were continuously recorded and statistically analyzed. Electrical conductivity of the soil solution was measured for both beds to determine salt distribution.

The scientists found that soil temperatures on the conventional bed were about 17° F. warmer than in the trenches by midafternoon but dropped quickly at night. Soil in these beds remained at low temperatures for about 12 hours.

Although the soil temperature in the trenches did not exceed 68° F. during the day, it did not drop as low during the night. Previous studies showed the nighttime temperature to be about 4° F. warmer in the trenches than on top of the beds.

Soil in the 0- to 3-inch depth range generally had 2 percent more water in the trenches than in the ridge treatment, reflecting the reduced exaporation associated with the lowered relief of the trench.

Visual observations indicated that wind speed within the trench was lower than on the ridge. Reduced wind speed, says Mr. Gonzalez, is one of the most favorable results of trench planting. □



Above: Dr. Kelsay examines vials in which salivary protein has been separated. Bands show the different protein fractions (871K1111-10). Right: Mrs. Joanne Holden obtains saliva sample with special suction cup (871K1110-16).



Saliva: New research tool

SALIVA offers a new approach to human nutrition studies of carbohydrates, serving as a substitute for blood in analyzing nutrition response. Because it can be collected with little stress on the subject, its use simplifies test procedures and permits the inclusion of more subjects.

In the past, the study of nutrition response in normal individuals was largely limited to analyses of blood, urine, and feces. But ARS research nutritionist June Kelsay at Beltsville, Md., found that blood and saliva have some components in common which are affected by carbohydrates in the same way.

These components are lactate, pyruvate, protein, and the enzyme, amylase. Lactate and pyruvate, products of intermediary carbohydrate metabolism, are important in the synthesis of protein and lipids from carbohydrates. Amylase splits starch molecules into glucose and is the only enzyme of any extensive activity found in the saliva studied.

This research is part of an ARS project to determine possibly undesirable effects of certain carbohydrates. The project may eventually lead to recommendations covering carbohydrate

intake of groups of people, particularly those who may be carbohydrate-sensitive.

Dr. Kelsay collects the saliva directly from the parotid glands as a pure secretion. These glands, one of three pairs that secrete saliva into the mouth, are located on the inner surface of each cheek opposite the second molar tooth. A small suction cup fitted over the gland opening allows the saliva to drain into a plastic tube. To stimulate the flow of saliva, the subject chews paraffin wax on the same side from which the collection is made.

In studying the response to carbohydrates of the blood and saliva components, Dr. Kelsay gave seven young women load doses of seven different carbohydrates (glucose, fructose, sucrose, lactose, corn starch, wheat starch, and potato starch) in rotation on seven different days. Venous blood and parotid saliva samples were collected after a 12-hour fast and at 1- and 2-hour intervals following ingestion of the carbohydrate.

Dr. Kelsay noted significant increases of lactate in both blood and saliva one hour after ingestion of fructose, sucrose, and lactose. The levels of pyruvate in both blood and saliva also

increased after these three carbohydrate forms were ingested, but because of the great variation in response of different subjects, the increase was significant only in saliva and only after sucrose. Responses to the other carbohydrates were not significant either for lactate or pyruvate.

Studies on the protein content of parotid saliva verified the work of other scientists, indicating that the protein can be separated into several fractions on acrylamide gel and that the most prominent fraction contains all of the amylase activity.

Dr. Kelsay was able to further separate the amylase fraction into several varying forms by extending the time for electrophoresis, the separation technique used. Two to four distinct fractions, or bands, having amylase activity were noted. It has been suggested that the number of bands may be due to hereditary characteristics. However, in the saliva samples from the seven subjects, individuals could not always be identified by the number of bands, although one subject frequently had four bands while another usually had only two. There were no significant increases in amylase activity due to any of the seven different carbohydrates. □

The Baroda Experiments

SOME ANSWERS TO PROTEIN DEFICIENCY

A BABY'S BRAIN at birth has all the nerve cells it will ever have, but most of its intricate physiological development continues on until the age of four or five. Since nearly half of the grey matter in a child's brain is protein, adequate protein in the diet during this early period is considered essential for normal brain development.

When the diets of young children are protein-deficient, however, at what stage do the children suffer intellectual stunting and at what stage is this condition preventable by an adequate diet?

Indian scientists working with rats on an ARS-sponsored Public Law 480 project — the Baroda experiments — have found some of the answers.

Dr. Mildred Adams, ARS-sponsoring scientist, says the Baroda experiments have provided much information basic to understanding the widespread problems of protein malnutrition, especially with regard to its possible effect on mental development and the functioning of the central nervous system.

In these experiments, the Indians fed rats two types of diets and then measured the effects of protein deficiency on behavioral performance and on brain biochemistry. The two types were: simple diets in which the content of individual nutrients could be varied and the low-protein diets consumed locally in Gujarat by preschool and school-age

children with or without supplements of natural foods that improve protein quality.

With the simple diets, the amount of casein (milk protein) was adjusted to 20 percent in the high-protein (HP) diet and to 5 percent in the low-protein (LP) diet.

Behavioral studies included maze and other tests to score memory, discrimination and reversal learning, spontaneous activity, and motor coordination.

To measure biochemical changes in the brain, the Indians studied enzymes involved in the metabolism of glutamic acid (an amino acid) because of its high concentration in the brain, and carbohydrates because brain glutamic acid is derived mainly from 2-oxoglutarate, part of the trigger system of carbohydrate metabolism. Glutamic acid is believed to facilitate certain essential ion (electrical) activity in the brain.

The Indian scientists confirmed that the effect of protein deficiency on behavior and brain biochemistry varied with the age at which this malnutrition occurred. After weaning, rats fed 5-percent protein responded poorly to the

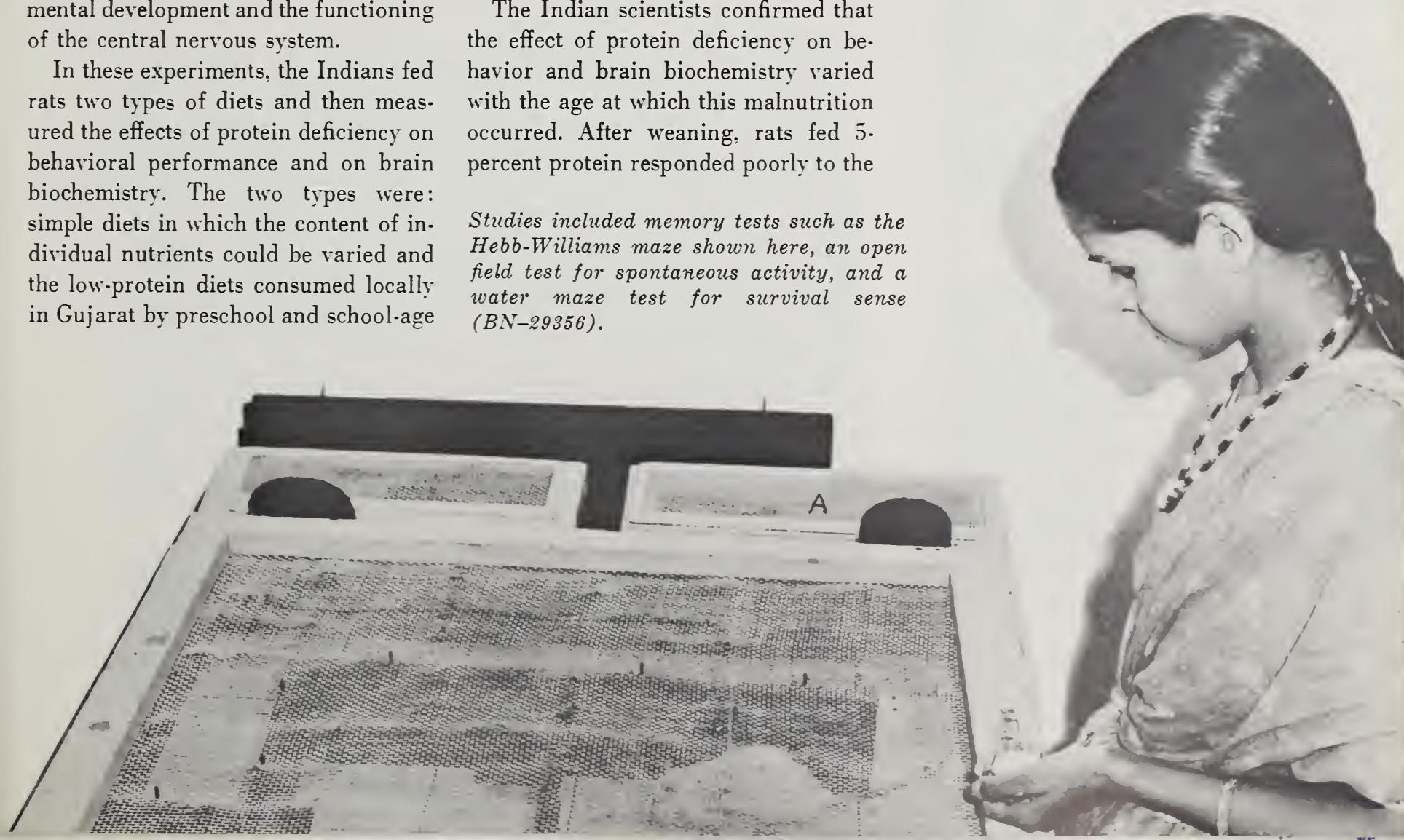
Studies included memory tests such as the Hebb-Williams maze shown here, an open field test for spontaneous activity, and a water maze test for survival sense (BN-29356).

behavioral tests as compared to those fed 20-percent protein. Also, the LP animals showed decreased activity of enzymes involved in glutamic acid and carbohydrate metabolism.

On the other hand, calorie deficiency after weaning did not affect brain enzymes but did adversely affect growth and to some extent brain weight. During the nursing period, calorie deficiency produced effects similar to the results of protein malnutrition after weaning.

In testing the low-quality Gujarati diet, the Indians found that the test group fed with a supplement of cheap, locally available legumes and greens had better maze performance and increased brain enzyme activity. This supplementation raised the quality of the Gujarati diet to a level comparable to a 10-percent casein diet.

This research was conducted at Baroda University under the direction of psychologist R. Rajalakshmi and biochemist C. V. Ramakrishnan. □



As the sun sets, fluorescent lights switch on to keep the caged test plots lighted for the 17-hour period—thereby interfering with nature's signal that fall is coming (1169A144-8).



JAMMING NATURE'S SIGNAL

CODLING MOTHS infesting apples and European corn borers infesting corn are being killed with light in caged field tests.

Many insects hibernate when daylight lasts no longer than 12 hours in the fall. Artificial lights, however, lengthen the days, thereby jamming nature's way of signaling the insects to hibernate, a state called diapause, which protects them from cold weather and lack of food in winter.

The field tests were conducted by biochemist Dora K. Hayes, entomologist William N. Sullivan, and chemist Milton S. Schechter, all of ARS, at Beltsville, Md., in 144-square-foot corn plots covered by cages. Natural daylength varied from about 9½ to 14 hours throughout the 6-month test period that ran from June to December.

The scientists mounted eight 40-watt fluorescent lamps above the corn plots to maintain 17-hour periods of light. The plots were artificially infested with 10 to 30 borers per plant. Clear plastic boxes containing 760 green apples infested with codling moth larvae were also exposed to the same lighting conditions.

As a result of the artificially extended days, codling moths and European corn borer larvae continued their development into adults without hibernating. They spun their cocoons, and the moths began to emerge in the fall instead of the following spring. In 2 years of experimentation, 76 to 95 percent of the European corn borers and 70 to 90 percent of the codling moth larvae failed to hibernate.

In similar tests made during the

same 6-month period, 70 percent of the European corn borers failed to hibernate when exposed to the same regimen of light from two 1,000-watt mercury lamps mounted over a 40- by 40-foot uncaged plot of corn.

Almost all of the insects in unlighted control plots went into their normal state of diapause or hibernation in the fall in all tests.

Much additional research is needed to obtain results under large field test conditions and to determine the best timing and minimum intensity of light as well as costs and other considerations before this approach can be recommended for practical application.

Biochemical studies of the mechanisms involved in the induction and the breaking of insect diapause are also underway. □



Left: ARS biologist Maria Oliver keeps complete records on the development of corn borers tested. Larvae were reared on artificial media until placed in the plots (1169A142-3).

Below: Mrs. Oliver examines apples held in the caged plots for codling moth larvae that are in diapause. If insects had not diapaused as a result of extended daylength, they would have developed into moths (1169A147-14).

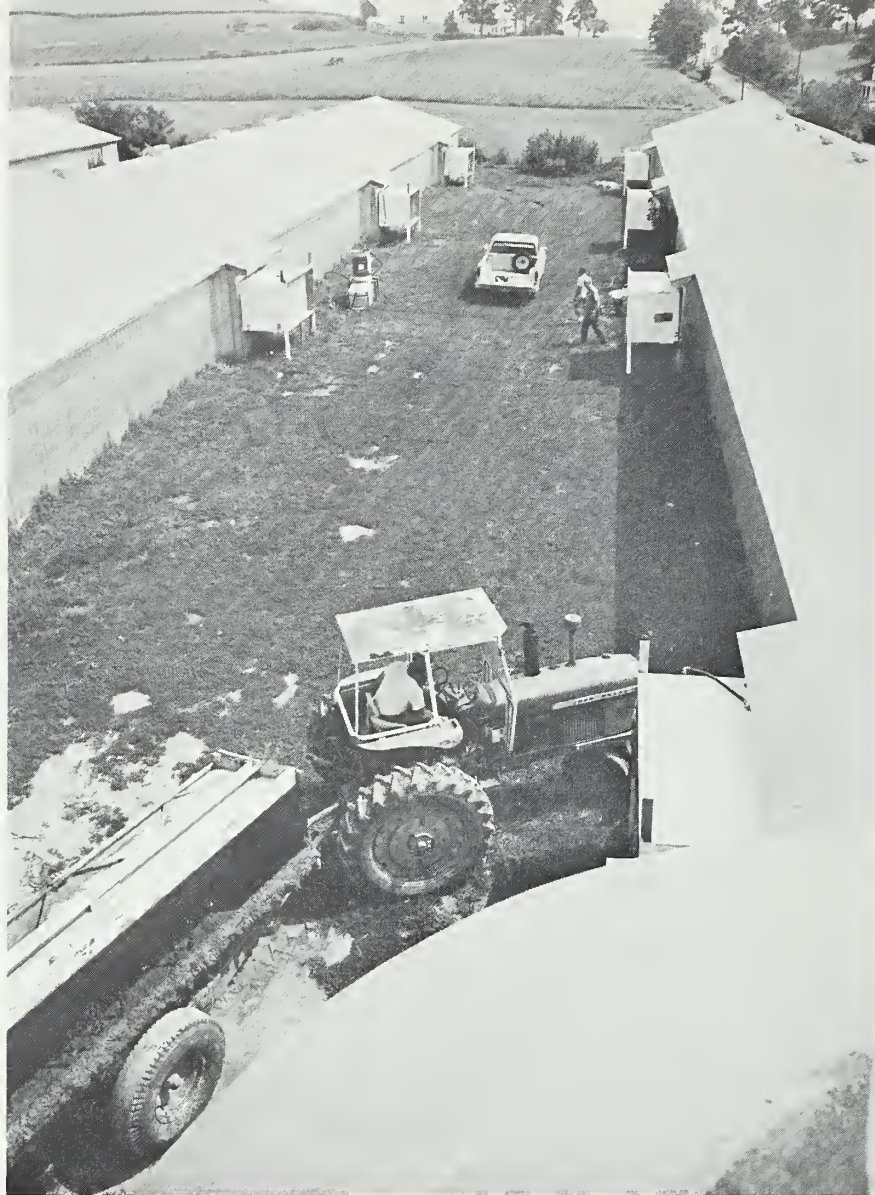


Above and left: Corn stalks from the plots are checked. Presence of corn borer larvae indicates that the insects, not responding to light, are diapausing. Pupae indicate that the insects are continuing development (1169A145-13; 1169A143-1).

Poultry houses that make good neighbors



Above: With housing removed, Mr. Willson tests water spray from the nozzles. When housing is in place, the spray hits baffles, runs to the bottom, and drains into storage tanks for reuse (971K1131-27). Right: Spray chambers jut from these poultry houses (971K1131-17).



IT'S EASIER to love your chicken-raising neighbor if you don't have to smell his birds.

Large volumes of exhaust air from windowless poultry houses are discharged during hot weather and accumulate around the houses. This air is loaded with dust and odors which constitute an aesthetic nuisance to surrounding residents, especially in highly populated areas.

Minor modifications of existing poultry house ventilation equipment—installing spray chambers—may make it possible to eliminate most of the odors and make better neighbors of poultry enterprises. At the same time, the spray chambers would eliminate some of the dust coming from inside the houses although, at present, the dust is the lesser of the two evils.

Of the number of management practices that can be used to reduce the odors from existing houses—frequent

removal of waste, rapid drying of waste in place, or masking the odors with deodorants—the water spray chambers seem to be the most feasible and economical. The chambers use modified existing equipment.

ARS agricultural engineer George B. Willson, College Park, Md., in cooperation with the Maryland Agricultural Experiment Station, built housings to fit over exhaust fans on a 12,000-bird, windowless poultry house. The house had seven 10,000 cubic-feet-per-minute exhaust fans, and was 42 feet wide and 200 feet long.

Zigzag baffles were installed in the housings to move the air outside by a circuitous route. Spray nozzles were installed in the housings between the fans and the baffles. The water, hitting the baffles as spray, ran to the bottom of the housing and was drained into a storage tank for reuse.

In the spray chamber, the water com-

bines with ammonia and other malodorous gases and carries them away in solution. Mr. Willson recommends a coarse spray because a coarse nozzle will be less subject to clogging with dust collected in the recirculated water. Also, baffles will be more efficient in removing the larger water droplets.

The baffles' prime function is to remove the spray from the air stream. Pressure drop through the baffle is low, but it will reduce the fan delivery. Installation in houses that do not have some reserve ventilating capacity will necessitate increasing that capacity.

Principal source of the odors appears to be decomposing poultry manure. Rate of decomposition depends on temperature and is slow during winter weather. Thus, most operators could shut down the system in the winter.

It may be installed outside or inside the houses and could be drained to prevent freezing. □

CONVEYING CORN

High impact velocity,
culprit in kernel damage

AN IMPROVED TECHNIQUE and a better understanding of how corn kernels are damaged stem from studies on transferring corn kernels at high velocities through pneumatic conveyors.

Much of the physical damage to corn during handling is caused by kernel impact against some object. This sometimes occurs with field shelling and free falling into deep concrete silos and bins but primarily occurs with grain throwing and conveying equipment used to handle grain for market. Increasing use of pneumatic conveyors has intensified the problems because too-high air velocities cause severe mechanical damage to kernels.

ARS agricultural engineer Harry H. Converse, working with agricultural engineer Duane L. Keller and nuclear engineers Ali F. El-Saiedi and Richard M. Rubin of Kansas State University, all at Manhattan, developed a new method to estimate particle velocity, the critical factor in estimating impact damage.

The researchers found that a radioactive tracer technique (RTT) could accurately measure particle velocity inside conveyor pipes. The technique produces reliable results immediately and at relatively low cost.

Two scintillation detectors are placed at a fixed distance apart along a pneumatic conveyor to detect radioactive kernels passing through the conveyor. When a kernel passes by the first scin-

tillator probe, it triggers a signal that is fed first into a ratemeter, then into a time interval counter. When the kernel passes the second probe, the signal stops.

RTT shows several advantages over the present technique—high-speed photography (HSP). Results are available immediately with no delay for film development, and RTT can be used with enclosed systems. HSP requires an open-ended system or one with a transparent section. No additional expense is incurred during operations with RTT.

Mr. Converse and Mr. Keller, working with agricultural engineers T. C. Hodges and D. S. Chung of Kansas State University, also ran studies with kernels pneumatically projected against selected materials to evaluate impact damage. Damage was determined as a function of five independent variables: impact velocity, impact surface, impact angle, kernel moisture, and kernel size or shape. RTT was used to measure impact velocity.

All of the variables affected impact damage. Impact velocity had the most effect; kernel size and shape, the least. Kernel damage increased as moisture decreased from 22 percent to 12 percent. Damage was greatest for kernels below 15-percent moisture. Damage with a urethane impact surface was one-fifth that with steel and one-sixth that with concrete. Reducing impact angle from 90° to 45° reduced damage 25 percent. □



Gibberellic acid KEEPS PANGOLAGRASS GROWING

Pangolagrass pastures in the tropics help increase beef production while controlling erosion (PN-1731).

ONE of the best pasture grasses in tropical and semitropical areas of the world is pangolagrass. Millions of acres are grown. But whenever nighttime temperatures drop below 50° F., usually from September to May, it virtually stops growing, reducing the amount of herbage for grazing.

ARS agronomist Sherlie H. West, assisted by University of Florida graduate students Joe H. Hilliard and Parviz Karbassi, and research associate Leon Garrard, have discovered why this growth reduction occurs and found a way to overcome it. The remedy: Treat the plants with gibberellic acid.

Dr. West and his coworkers discovered that cold weather interferes with the process of moving starch out of the chloroplasts, cell structures where photosynthesis occurs. Using an electron microscope, they found that in pangolagrass, the chloroplasts were much larger in plants exposed to low nighttime temperatures than in those exposed to high temperatures. This in-

crease in size is caused by the accumulation of starch granules which was 5 to 20 times greater than in normal chloroplasts.

Thus, during the warm daytime, the plant carries on photosynthesis so rapidly that it cannot use all of the starch produced for growth during the day. So it stores the starch for use at night when photosynthesis does not occur. If the nighttime temperature falls below 50° F., the starch is not utilized, and the plant does not grow.

Storing large quantities of starch can injure and even burst the chloroplasts. Consequently, the plant must use much of the starch to replace or repair damaged chloroplasts instead of to support new growth.

Moreover, in the tropical plants, one of the amylotic enzymes, which degrade starch, was reduced by cool nighttime temperatures. In temperate plants, the same enzyme's activity was enhanced by cool temperatures.

Once the exact problem was known,

Dr. West and his colleagues had no problem finding a cure. Gibberellic acid, a substance produced by a fungus, causes various responses in plants. It is known that the acid increases the activity of the enzyme that degrades starch.

By spraying the grass with a low concentration of gibberellic acid, the effects of low night temperatures are effectively wiped out. Enzyme activity is increased, and the accumulated starch is converted to soluble sugars and mobilized for growth. More testing, however, is necessary to determine how long the treatment will last, or whether additional treatments will be needed.

Such a treatment would significantly increase the yields of pangolagrass. The current effects of low nighttime temperatures reduce yield by two-thirds or more. It is conceivable that the use of gibberellic acid could increase pangolagrass yields by 200 percent or more, fully utilizing pasture lands and providing year-round grazing. □

Broken kernels harbor aflatoxin

AFLATOXIN in corn may be reduced or eliminated by removing all broken kernels and foreign material including chaff from the corn.

Aflatoxin, a mold-produced toxin harmful to vertebrates, can be a major problem in stored corn, and a quick, simple method for removing it is needed.

ARS chemists Robert M. Johnson and Walter T. Greenaway and technician William P. Dolan, Beltsville, Md., found that aflatoxin concentrates in the broken kernels and foreign material. They attribute this to the fact that corn may crack when it is handled after being dried, and a cracked kernel is very susceptible to aflatoxin-producing fungi.

If the corn is contaminated with aflatoxin, the researchers suggest separating the broken corn and foreign material from whole kernels as a possible and effective means of aflatoxin control.

The ARS team tested this idea on 21 contaminated samples and found that aflatoxin was reduced to a mere trace-level for all but one sample, which had an unusually large amount of dockage.

In the laboratory, separation is done by sieving; then the dockage is run through a chromatography test to determine percentage of aflatoxin. A high percentage figure indicates contamination within the corn kernels themselves. This method is not done commercially. □



UV light detects corn mold

A NEW and nondestructive technique for detecting mold in individual kernels of corn may one day bring objectivity to corn inspections.

The technique is based on fluorometry. When exposed to ultraviolet light, the germ of a sound kernel will fluoresce, while a germ blanketed by mold will not, or will do so at a reduced rate.

At present, corn inspectors must scrape away part of the germ area of each questionable kernel to determine the extent of mold contamination. The

new technique is much simpler, more objective, and can be used in automatic sorting. It was developed by agricultural engineer Gerald S. Birth of Purdue University, Lafayette, Ind., and ARS chemist Robert M. Johnson at Beltsville, Md.

Dr. Johnson and Mr. Birth select a sound kernel as a "standard," then compare its fluorescence to the fluorescence of damaged corn. The amount of fluorescence reduction indicates the extent of mold contamination. □

New weapons against mosquitoes

TEN NEW experimental insecticides show promise for controlling adult mosquitoes when applied in ultra-low volume (ULV) cold aerosols.

These compounds, consisting of carbamates, organophosphates, and synthetic pyrethrins, may widen the arsenal of effective insecticides against mosquitoes in case the insects develop resistance to materials now used.

ULV cold aerosols are coming into increasing use. They were so named because the traditional way of vaporizing them with heat is not employed. In-

stead, they operate on the principle of atomization and high volume of air and employ special nozzles.

Applying these insecticides in ULV cold aerosols instead of the conventional thermal aerosols would decrease the amounts needed by 50 percent or more, thus reducing costs and the possibility of environmental pollution. They offer two other advantages over conventional aerosols. First, formulating facilities are not needed because ULV aerosols don't require solvents, carriers, and additives. Second, the ULV aerosols don't produce the dense fogs that are typical of thermal aerosols; this helps eliminate a potential traffic hazard when fogging is done along roads (AGR. RES., Sept. 1968, p. 8).

ARS entomologist Gary A. Mount and technician Ned W. Pierce, Gainesville, Fla., tested the new insecticides and a standard one, malathion, against caged, adult female mosquitoes. Six of the new insecticides were more effective than malathion. Four were either equal to or slightly less effective than malathion.

More studies are necessary to further test effectiveness and to assess the impact of these new compounds on the environment. None of them is Federally registered for use on mosquitoes. Before a pesticide can be released to the public, it must undergo stringent tests by its manufacturer, who submits data to the Federal government for evaluation and registration. □



Photos contrast the conventional thermal apparatus, which produces dense fogs, with the ULV cold aerosol, which emits only a fine mist (ST-3739-3, BN-38013).



Thinning peaches

A MAJOR PROBLEM of peach producers appears nearer solution after 3 years of research with a new chemical thinner.

Thinning of some peach varieties is usually necessary because they set and mature too many unsalable small fruit. Shortage and high cost of labor make hand thinning impractical, and available chemical thinners are either ineffective or cause unacceptable damage to the leaves.

Plant pathologist Harry L. Keil and horticulturist Harold W. Fogle, Belts-

ville, Md., thinned peaches with the new chemical MATB (1,1,5,5-tetramethyl - 1 - 3 - dimethylaminodithiobiuret). They had evaluated MATB for control of "shot-hole," a peach tree disease, when they noted an injury similar to that sometimes caused by chemical thinners. This observation prompted evaluation of MATB as a peach fruit thinner.

One spray application of MATB, when the ovule length was 7 to 10 millimeters, resulted in desirable thinning of several hard-to-thin peach varieties.

Concentrations of 100 to 300 parts per million satisfactorily thinned Earlired, Rio-Oso-Gem, Redskin, Redhaven, and Ranger with minimum leaf damage.

MATB is not registered for use as a peach thinner. Additional research is needed to establish precise application time and determine the effects of various environmental factors. Before MATB can be released to the public, it must undergo stringent tests by its manufacturer, who then submits test data to the Federal government for evaluation and registration. □

Big pill kills cattle parasites

Parasites are thieves, stealing nutrition from cattle and dollars from beef producers. But naphthalophos, an experimental drug, is proving more than 93 percent effective in killing parasitic thieves.

Naphthalophos, given cattle in the form of a "big pill" or bolus, was used by ARS parasitologist Honorico Ciordia to kill internal parasites. The drug had no apparent adverse affect on the cattle in tests at Experiment, Ga.

Four naturally infected yearling steers were chosen as the experimental animals. After 6 days in individual stalls, the steers were each given 50 milligrams of naphthalophos per kilogram of body weight. The following day, 89 percent of the total worms recovered were found. The remaining worms were recovered the second day.

Naphthalophos effectively killed 98 to 100 percent of the common stomach and small intestinal round worms; 93 percent of the medium stomach worms; 82 to 83 percent of the small intestinal and hair worms; and 50 to 73 percent of the hookworms, nodular worms and whipworms.

Naphthalophos is not registered in the United States for use on cattle. Before a pesticide can be released to the public, it must undergo stringent tests by its manufacturer, who then submits test data to the Federal Government for evaluation and registration.

Jersey calf defect inherited

"Limber legs" in Jersey calves, a condition in which calves are unable to control their legs, is inherited.

The first reports of limber legs were made in 1969. Since then, the condition has been reported in several Jersey herds across the country. Both female and male calves are affected.

Affected calves appear normal, but they are unable to stand and their legs can be easily rotated or bent with no visible discomfort to the calf. Normal

muscling of the legs is apparently lacking, and the joints are loose. These calves are a complete loss to the dairyman.

ARS dairy scientist Robert C. Lamb with Clive W. Arave and veterinary pathologist James L. Shupe of the Utah Agricultural Experiment Station, Logan, determined through a pedigree analysis of affected calves that the defect was genetically controlled. All affected animals were closely related.

Though the scientists do not know exactly how the condition is inherited, they believe it is controlled by a simple recessive gene. This means that half the sons and daughters of carrier bulls will be carriers.

Further research is underway with known and suspected carriers to provide Jersey breeders more information on how to avoid this problem.

Quick test for cotton sugar

A new and much needed rapid method for categorizing cottons by sugar content is simple, reliable, and does not need complex equipment or specially trained technicians.

High-sugar cottons are difficult to process because of stickiness. Trouble starts at the picker calendar rolls and becomes progressively more severe as the stock advances to the card crush rolls and spinning operation. Potentially troublesome high sugar bales should be screened out to facilitate operations.

Present methods for measuring sugar content have some merit but are time consuming and often require elab-

orate equipment and techniques. ARS chemist Henry H. Perkins, Jr., stationed at Clemson, S.C., developed the new technique which can test hundreds of samples in a day.

Mr. Perkins' screening method is based on the reaction of alkaline potassium ferricyanide with the reducing substances (primarily sugar) in cotton. By adding enough of the potassium ferricyanide to react with a specific amount of sugar and by controlling cotton sample weight, Mr. Perkins' group can determine by the color of the solution whether sugar content is above or below a preset percentage.

Mr. Perkins used 0.35 percent sugar as the critical point. Cotton bales with sugar readings below this percentage are not expected to be troublesome.

In a recent test involving 600 cotton bales, quantitative sugar tests showed that Mr. Perkins' screening method correctly predicted sugar level in more than 97 percent of the bales.

AGRISEARCH NOTES

When reporting research involving pesticides, this magazine does not imply that pesticide uses discussed have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.



AGRISEARCH NOTES

Supermarket computers cut costs

Retail food stores in the United States could be saving approximately \$1 billion annually through nationwide use of a computerized checkout system.

Savings estimates are based on an economic evaluation of the optical scanning computerized checkout system (AGR. RES., Nov. 1970, p. 3) and a hypothetical supermarket with \$4 million annual sales. The evaluation was made under a cooperative research agreement by ARS and Indiana State University, Terre Haute.

Operating costs in this computerized checkout system were reduced by 51½ percent, with slight variations depending on whether the shopper or the checker unloaded the shopping cart onto a conveyor belt.

Checkout speed was increased 19

percent, while checkout errors were reduced 57 percent. It was estimated that a checker's training time could be reduced by 33 percent, and inventory and ordering time could also be cut.

Results of this study indicate that a retail store with \$4 million annual sales could realize \$45,000 annual savings. This figure does not include estimates for presumed additional savings resulting from having current, accurate product and management information.

These substantial potential savings justify the establishment of test installations, recognizing that the computerized checkout system's full potential will not be realized for a few years.

Reducing rot in sugar beets

Selecting sugar beets for resistance to *Cercospora* leaf spot may also reduce rotting losses during storage by as much as 50 percent.

Sugar beets regularly pile up at processing plants after the harvest, and they may remain in storage for several months before they are processed. Sugar loss due to natural respiration

and rotting caused by micro-organisms is high in these storage piles.

In sugar beet research, plant geneticist Garry A. Smith and plant pathologist Earl G. Ruppel, both of ARS at Fort Collins, Colo., selected beets in the field and graded them for their resistance to spotting. The beets were harvested and placed in nearly ideal facilities for 144 days. At the end of the storage period, the low leaf spot-resistant beets showed a rotting loss of 10.3 percent. The beets selected for their high leaf spot-resistance showed a loss of only 4.6 percent. Colorado Agricultural Experiment Station cooperated in the study.

Why leaf spotting predisposes beets to storage rot is not known. Losses in sucrose content noted in beets affected by leaf spotting before storage may be a contributor, but further study is needed.

Earworm resistance for sweet corn

Corn earworms in sweet corn may be most effectively controlled by first selecting resistant hybrids. Then less reliance on insecticide is needed when infestations occur.

These observations come from research by entomologists William W. McMillian and Billy R. Wiseman, geneticist Neil W. Widstrom and agricultural engineer Edsel A. Harrell, all of ARS, in cooperation with Georgia Agricultural Experiment Stations, Tifton.

After a heavy artificial infestation of corn earworms, an experimental resistant sweet corn hybrid, 471-U6 X 81-1, that was not treated with insecticide had 48 percent more damage-free ears than a susceptible sweet corn hybrid treated with seven applications of 2-chloro-1-(2,4,5-trichlorophenyl) vinyl dimethyl phosphate.

When the resistant hybrid was treated with the insecticide and exposed to an artificial infestation, it had 4 percent more damage-free ears than when untreated. With a natural infestation, it had 15 percent more damage-free ears than when untreated.

Mrs. Sharon Flemming touches electronic scanner to coded label on grocery item. Scanner reads code and sends the data to a computer which identifies the product and its price. The name, total price, and unit price of the product is relayed to a tabulator and printed on the receipt tape (0770A614-7).



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 Witchweed. Sep—7
 See also Herbicides
Winter cabbage, herbicides for. Apr—16
Witchweed, fungi that kill. Sep—7
Wool:
 Improved, from crossbreds? Apr—16
 Shearling bedpads. Apr—15
 Treated, doesn't ignite. Jan—15